

Physics 11 Work, Mechanical Advantage and Efficiency

Name _____ block _____

Purpose: determine the mechanical advantage and efficiency of 2 pulley systems and 2 levers.

Theory: Work = Force x distance in Joules

Mechanical Advantage = F_{out}/F_{in} Ideal MA = D_{in}/D_{out} No unitsefficiency = $W_{out}/W_{in} \times 100\%$ in %

Procedure:

- Setup a pulley system or a lever to lift a mass, draw the setup in the space below.
- Measure the F_{in} , D_{in} , D_{out} , and record the masses to calculate the F_{out} by $F=mg$.
- Determine the Ideal mechanical advantage by $IMA = D_{in}/D_{out}$
- Calculate the mechanical advantage $MA = F_{out}/F_{in}$
- Determine the efficiency = $W_{out}/W_{in} \times 100\% = F_{out}D_{out}/F_{in}D_{in} \times 100\%$
- Compare the efficiency to the percentage uncertainty of your most imprecise measurement. For example, if your force is 1.2 N \pm 0.2 N that is $0.2/1.2 \times 100\% = 17\%$ uncertainty.

Table continued on back

Drawings - include predicted F_{in}	data	IMA calc	MA calc	Efficiency calc
Lever system 1 	F_{in} _____ D_{in} _____ D_{out} _____ Hanging Mass _____ Mass of moving pulleys or metre stick _____ Calculate F_{out} _____ $0.24 \times 9.8 \frac{N}{kg} = 2.4N$	$\frac{D_{in}}{D_{out}} = \frac{60}{40} = 1.5$	$\frac{F_{out}}{F_{in}} = \frac{2.4}{1.5} = 1.3$	$\frac{F_{out} \times d_{out}}{F_{in} \times d_{in}} = \frac{2.4 \times 4}{1.5 \times 6} = 89\%$
Lever system 2	F_{in} _____ D_{in} _____ D_{out} _____ Hanging Mass _____ Mass of moving pulleys or metre stick _____ Calculate F_{out} _____			
Drawings	data	IMA calc	MA calc	Efficiency calc
Pulley system 1	F_{in} _____ D_{in} _____ D_{out} _____ Hanging Mass _____ Mass of moving pulleys or metre stick _____ Calculate F_{out} _____			
Pulley system 2	F_{in} _____ D_{in} _____ D_{out} _____ Hanging Mass _____ Mass of moving pulleys or metre stick _____ Calculate F_{out} _____			

% uncertainty of your least precise measurement =

Were any machines were more efficient than the uncertainty? Why/why not?

$1.2 \pm 0.2 N$ $1.2 N$ 17%

$$\pm 0.2 \text{ N}$$

$$\frac{0.2 \text{ N}}{1.5 \text{ N}} \times 100\% = 13\%$$

$$100\% - 89\% = 11\% \text{ smaller than } 13\%$$

$$4.0 \text{ cm} \pm 0.1 \text{ cm}$$

$$\uparrow$$

$$2.5\%$$